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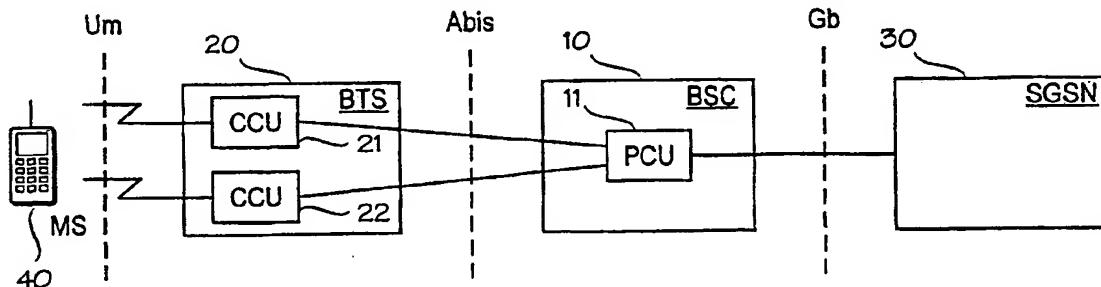
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(54) Title: SENDING PERMISSION ASSIGNMENT IN TELECOMMUNICATIONS SYSTEM



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(57) Abstract: A method for assigning sending permissions in a telecommunications system and a telecommunications system comprising a unit (20) providing access to said system for at least one telecommunication terminal (40) and a control unit (11) for scheduling data transfer between said at least one telecommunication terminal and the telecommunications system, whereby the control unit (11) is located apart from the access providing unit (20) and whereby said data transfer takes place on at least one transmission channel and more than one telecommunication terminal is arranged to use the same transmission channel so that a telecommunication terminal is allowed to send on the transmission channel when a sending permission is assigned to said telecommunication terminal, whereby the access providing unit (20) is arranged to assign a sending permission to the telecommunication terminal.

SENDING PERMISSION ASSIGNMENT IN TELECOMMUNICATIONS SYSTEM

BACKGROUND OF THE INVENTION

The invention relates to assigning sending permissions in a telecommunications system.

5 The general packet radio service GPRS is a new service in the GSM system. The GPRS subnetwork includes a number of packet data service nodes SN, which will be called serving GPRS support nodes SGSN in this application. Each SGSN is connected to a GSM mobile communication network (typically to a base station controller BSC or to a base station BTS in the 10 base station system) to allow the SGSN to provide packet service for mobile data terminals via several base stations, i.e. cells. The intermediate mobile communication network provides a radio interface and packet-switched data transmission between the SGSN and the telecommunication terminal i.e. mobile stations (MS). Different subnetworks are connected to an external data 15 network, e.g. to a public switched data network PSPDN, via GPRS gateway support nodes GGSN. Thus the GPRS service enables packet data transmission between mobile stations and external data networks as the GSM network functions as a radio access network RAN.

20 In the GPRS network data packets arriving from several users are sent using the same radio channel. Therefore, the unit responsible for timing, i.e. the packet control unit (PCU), has to be able to decide in which radio frame each data packet is sent. The PCU assigns sending permissions for mobile stations sharing a radio timeslot (TS), i.e. tells which mobile station may transmit and when. The packet control unit may be separate from the 25 actual unit providing the radio interface. According to GPRS specifications, PCU may be located at a base station (BTS), a base station controller (BSC) or an SGSN site.

30 A GPRS block period (BP) is a sequence of four time slots on a PDCH (Packet Data Channel) used to convey one radio block. A radio block is a sequence of four normal bursts carrying one RLC/MAC (Radio Link Control/Medium Access Control) protocol data unit, i.e. a RLC/MAC block which is a data unit exchanged between RLC/MAC entities. The block period is approximately 20 ms corresponding to the period that the transmission of one RLC/MAC block over the Abis interface lasts.

In case dynamic allocation is used for uplink transmission, the PCU assigns a mobile station uplink sending permission by including USF (Uplink State Flag) allocated for the mobile station in downlink RLC/MAC block's MAC header. Mobile stations observe the time slots allocated to their uplink transmission and in case a mobile station recognizes its own USF in downlink RLC/MAC block's MAC header, the mobile station may transmit in the uplink direction on the next block period.

In case fixed allocation is used for uplink transmission, the PCU assigns a mobile station uplink sending permissions in an assignment bitmap. The mobile station does not have to monitor downlink RLC/MAC blocks to find out whether the mobile station may transmit or not. Based on the assigned bitmap the mobile station knows in advance when the mobile station may transmit.

The PCU may also poll a mobile station using a RRBP (Relatively Reserved Block Period) field in the MAC header. For example, in case of downlink transmission, the PCU may include a valid RRBP field in a downlink RLC/MAC data block which causes one uplink block period reservation for the mobile station. In the allocated block period the mobile station shall send a Packet Downlink Ack/Nack message to the PCU and acknowledge received blocks. In the Downlink Ack/Nack message the mobile station may also indicate if it has data to be sent.

In case a mobile station is transferring real-time (RT) traffic, the mobile station needs more sending permissions than a mobile station transferring non-real-time (NRT) traffic in order to meet delay and throughput requirements. An RT mobile station should be able to start transmitting data quite soon (within 40 to 60 ms, for example) after having data at the RLC/MAC layer (e.g. when a user starts to talk).

An RT mobile station having a silent period (i.e. having temporarily no data to transmit e.g. because the user is not talking) is polled in order to learn if the mobile station has data to be transmitted. When the PCU is located apart from a BTS site (in a BSC, for example), the time between sending the polling command and receiving a response from the MS is several block periods (BPs). The delay can be around 8 BPs (160ms) which consists of the following components: PCU to BTS transmission takes 3 BPs (approximate value, due to e.g. delay caused by buffering inside the BTS), BTS to MS transmission takes 1 BP, MS to BTS transmission takes 1 BP, BTS to PCU transmission takes 1 BP.

transmission takes 3 BPs. Thus the PCU learns only about 8 BPs after polling the mobile station if the mobile station has more data to transmit.

The PCU has currently two ways to schedule (assign a sending permission) a mobile station if the PCU is located apart from a BTS site:

- 5 1) The PCU could poll the mobile station every now and then and start assigning sending permissions to the mobile station only after learning the mobile station has more data to transmit. It would take around 12 BPs (8 + 4) before the mobile station would be able to transmit data at normal phase.
- 10 2) The PCU could assign a sending permission to the mobile station e.g. every second BP. When the PCU learns the mobile station has more data to transmit, the PCU starts assigning sending permissions to the mobile station more frequently (e.g. at every BP). Before the mobile station receives sending permissions frequently enough, the mobile station may use the already sent polling permissions to start sending data.
- 15 The alternative 1 is probably much too slow and thus would give unacceptable transmission delay for an RT mobile station. The alternative 2 may give acceptable service for the RT mobile station in case the PCU polls the mobile station frequently enough. However, the polling sending permissions the RT mobile station uses to start its transmission may not be enough
- 20 to satisfy the delay and throughput characteristics. Furthermore, sending permissions are wasted if the mobile station is polled frequently and it has nothing to send.

BRIEF DESCRIPTION OF THE INVENTION

The object of the invention is to provide a method and an apparatus 25 implementing the method to eliminate the above-mentioned problems. The object of the invention is achieved by a method and an arrangement which are characterized by what is disclosed in the independent claims 1, 21 and 37. The preferred embodiments of the invention are disclosed in the dependent claims.

30 The invention is based on the idea that a unit (e.g. a base station) providing access to a telecommunications system for telecommunication terminals (e.g. a mobile station) participates in an uplink sending permission assignment procedure when a control unit (e.g. a packet control unit) that schedules data transfer between the telecommunication terminal and the telecommunications system is not located at said access providing unit.

An advantage of the method and arrangement of the invention is that it enables enough sending permissions to be assigned for a telecommunication terminal, when the telecommunication terminal has more data to be transmitted after a silent period, and thus enables the more efficient use of 5 resources. The invention is especially advantageous when transmitting real time traffic.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in greater detail by means of preferred embodiments with reference to the accompanying drawings, in which

10 Figure 1 is a block diagram of a data transmission system according to a preferred embodiment of the invention,

Figure 2 illustrates a multi-frame structure of a PDCH channel of the GPRS system,

15 Figure 3 illustrates structures of an RLC/MAC block and a radio block,

Figure 4 illustrates a message sequence diagram according to an embodiment of the invention,

Figure 5A illustrates sending permissions assigned by the PCU,

Figure 5B illustrates sending permissions assigned by the PCU and

20 Figure 5C illustrates sending permissions after the modification by the BTS according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is applicable to different telecommunications systems, e.g. to the GSM system together with the general packet radio service (GPRS). In the following, the preferred embodiments of the invention are described by means of the GPRS/GSM radio system without limiting the invention to this particular radio system. The invention is not limited to systems utilizing a radio path either.

30 Figure 1 illustrates, in respect of the parts relevant to understanding the invention, the basic architecture of the GSM system and the architecture of a GPRS packet radio network implemented in the GSM system. The basic structure of the GSM network consists of two parts: a base station system (BSS) and a network subsystem (NSS). The BSS and mobile stations (MS) 40 communicate via radio connections over a radio interface Um. In the base station system BSS each cell is served by a base transceiver station (BTS) 20.

The base station 20 is connected to a base station controller (BSC) 10, which controls the radio frequencies and channels used by the base station. The base station controller 10 is further connected to a mobile switching centre (MSC, not shown). As regards a more detailed description of the GSM system, 5 reference is made to the ETSI/GSM recommendations and to *The GSM System for Mobile Communications*, M. Mouly and M-B. Pautet, Palaiseau, France, 1992, ISBN: 2-9507190-07-7.

Figure 1 also illustrates a support node 30 of the GPRS system, which is connected to the GSM system. The serving GPRS support node 30 is 10 a node which serves the mobile station 40. Each support node SGSN manages the packet data service in the area of one or more cells in a cellular packet radio network. For this purpose, each support node SGSN is connected (Gb interface) to a certain local part of the GSM mobile communication system. This connection is typically made to the base station system BSS, i.e. 15 to the base station controller BSC (as in Figure 1) or to one of the base stations BTS. The mobile station 40, which is in the cell, communicates with the base station 20 over the radio interface Um and further through the mobile communication network with the support node 30 to the service area of which the cell belongs. In principle, the mobile communication network between the 20 support node 30 and the mobile station 40 only transmits packets between these two. The mobile communication network provides a physical connection for transmission of data packets between the mobile station 40 and the serving support node 30. Additional information on the GPRS and the protocols used therein can be obtained, if needed, from ETSI (European Telecommunications 25 Standards Institute) GPRS specifications.

The base station system and the serving support node are connected by a Gb interface which enables exchange of signalling information and data. To be more precise, the Gb interface is located between a packet control unit (PCU) 11 and the SGSN 30. The packet control unit is a functional 30 unit which is responsible for different functions in the GPRS MAC (Medium Access Control) and RLC (Radio Link Control) layers. These functions include establishment of RLC/MAC blocks for downlink transmission (towards the mobile station), de-assembly of blocks for uplink transmission (towards the network), timing of PDCH (Packet Data Channel), channel access control functions (access request and access grants) and management functions of the 35 radio channel, such as power control, allocation and release of radio channels

and broadcast of control information, for example. Figure 3 illustrates the structure of an RLC/MAC block which consists of two parts which are the MAC header and an RLC data block or an RLC/MAC control block. All downlink RLC/MAC blocks comprise an USF (Uplink State Flag) field in the MAC header which indicates the owner or use of the next uplink radio block on the same time slot.

The packet control unit is connected to a channel codec unit (CCU) 21 and 22 by means of an Abis interface. The functions of the channel codec unit include channel coding functions (including codirectional error correction 10 FEC and interleaving) and measuring functions related to the radio channel. The channel codec unit also establishes GPRS radio blocks, i.e. GPRS packets in which the data and signalling information, i.e. RLC/MAC protocol data 15 units, are sent over the radio interface Um. The channel codec unit 21 and 22 is always located in the base station 20, but the PCU has a variety of alternative locations: base station BTS, base station controller BSC (as in Figure 1) or support node SGSN. When the PCU is separate from the BTS, the CCU (or some similar unit within the BTS) may control some of the PCU functions.

When the packet control unit 11 is separate from the base station 20, data is transmitted between the packet control unit 11 and the channel 20 codec unit 21 or 22 over the Abis interface using PCU-TRAU frames which are extensions of the TRAU (Transcoder/Rate Adaptor Unit) frames. Both GPRS data signals and GPRS MAC/RLC control signals on a PDTCH (Packet Data Traffic Channel) are transmitted in the PCU-TRAU frames.

Over the air interface Um traffic is transmitted in blocks which are 25 provided by the physical layer of the OSI model. The duration of each physical block (radio block) is four GSM bursts, which are sent in sequence on one physical channel (time slot). Figure 2 illustrates the multi-frame structure of a PDCH channel which comprises 52 TDMA frames. Each of the radio blocks B0 to B11 is divided into four TDMA frames. There is also one idle frame (denoted 30 by X in the figure) at the intervals of three radio blocks. Figure 3 illustrates the structure of a radio block. Each radio block B0 to B11 consists of three parts which are the MAC header, RLC data block or RLC/MAC control block and check block BCS (Block Check Sequence).

The invention proposes that the BTS participates in the uplink 35 sending permission assignment procedure when the PCU is not located at the BTS site. In the following a preferred embodiment of the invention is described

with reference to Figure 4 illustrating a message sequence diagram according to an embodiment of the invention. The PCU polls the MS every Nth BP (e.g. every second or third BP). Polling can be done e.g. by assigning the MS an uplink sending permission by e.g. including an USF (Uplink State Flag) allocated for the mobile station in a downlink RLC/MAC block's MAC header whereupon the MS may transmit in the uplink direction on the next block period as described earlier and response to the polling. Polling can also be done e.g. by using a Packet Polling Request message with an RRBPF field in the MAC header. When an MS is being polled, the PCU preferably notifies the 5 BTS about it. The notification is given e.g. as part of PCU-TRAU frame control information in which the RLC/MAC block containing the polling command is transferred (51) from the PCU to the BTS. When the BTS receives such a polling command, it saves some parameters associated with the PCU-TRAU 10 frame containing the RLC/MAC block in which the MS is being polled and forwards (52) the RLC/MAC block to the MS. Such saved parameters are e.g. the 15 id of the MS to be polled (e.g. the USF in the MAC header), preferably the Tx power level the BTS will use when sending the RLC/MAC block in the air and optionally the description of other time slots the MS is using. The MS id may be given separately along with the polling command or the BTS may decode 20 the id from the received RLC/MAC block (e.g. the USF from the MAC header of the RLC/MAC block). When the BTS receives a response (53) from the MS, the 25 BTS observes if the received frame indicates the MS has data to be transmitted. Such an indication may be e.g. an RLC/MAC data block instead of e.g. a Packet Uplink Dummy Control Block in which case the Packet Uplink Dummy Control Block would indicate that the MS has no data to be transmitted at the moment. The response containing RLC/MAC block is forwarded (54) to the PCU.

In case the MS indicates that it has no data to be transmitted at the moment, the BTS continues with the normal operation.

30 In case the MS indicates it has more data to be transmitted, the BTS operates in the following way:

When the BTS receives (55) subsequent PCU-TRAU frames for the radio timeslot (and optionally for other time slots the MS is using) from the PCU, the BTS replaces the MS id (e.g. the USF) in the RLC/MAC block which 35 assigns a sending permission to the MS and forwards (56) this modified

RLC/MAC block to the MS. Thus the MS is given sending permissions immediately.

5 The BTS preferably uses the Tx power level and other important parameters received along with the original polling command. In case the BTS receives subsequent PCU-TRAU frames containing an RLC/MAC block or a sending permission for the MS, the BTS preferably replaces the Tx power level and other important parameters with the parameters received in the most recent PCU-TRAU frame.

10 The BTS preferably considers parameters saved for the MS and received with a new PCU-TRAU frame when sending the RLC/MAC block in the air. It may happen that in a PCU-TRAU frame the PCU assigns a sending permission for the MS, but RLC contents of the RLC/MAC block are destined to some other MS and thus e.g. the Tx power level suitable for both MSs must be considered when sending the RLC/MAC block in the air.

15 In case the BTS has replaced the sending permission with MS's id and the MS indicates that it has no more data to transmit at the moment, the BTS stops, according to a preferred embodiment of the invention, replacing the id of the MS into RLC/MAC blocks and may remove information associated with the MS. The BTS continues with the normal operation, i.e. sends 20 RLC/MAC blocks received from the PCU in the air without modifying sending permissions.

25 In case the BTS is to assign sending permissions to the MS but the PCU sends an idle PCU-TRAU frame in the downlink direction which does not contain a valid RLC/MAC block, the BTS will preferably either generate a RLC/MAC block (e.g. a Packet Downlink Dummy Control Block) in which the BTS sets an MS id or the BTS will omit the sending permission.

30 Alternatively, in case the fixed allocation is used for the uplink transmission, the BTS may assign the MS uplink sending permissions in an assignment bitmap by forming an Assignment message in which a certain amount of sending permissions are allocated to the MS and sending this message to the MS. The MS can continue its uplink sending according to the assignment bitmap sent by the BTS. The MS using such fixed allocation can be polled by using e.g. a Packet Polling Request message or the PCU can provide the MS when the data transmission stops temporarily with an assignment 35 bitmap allowing the MS to send every now and then.

According to a preferred embodiment of the invention the PCU may use a new bit called RI (Replace Indication), for instance, in the PCU-TRAU frame that is sent to the BTS. When the RI bit is set to '1', the BTS may replace information that assigns a sending permission to a MS (e.g. a USF) in

5 the next RLC/MAC block that is sent in the downlink direction, in case the MS has indicated it has data to be transmitted, even if the original RLC/MAC block received from the PCU assigns a sending permission to some other MS. In case the RI bit is set to '0', the BTS may not replace the MS id assigning a sending permission in the RLC/MAC block.

10 In order to avoid double reservations for the same BP owing to the BTS being able to replace a sending permission assignment made by the PCU, the following mechanisms may be used according to preferred embodiments of the invention:

The RI field in the above described PCU-TRAU frame is used.

15 When the PCU allocates a sending permission to e.g. an MS making two phase access or when the PCU e.g. polls an MS with an RRBP field in an RLC/MAC block or in any similar situation when the sending permission allocated by the PCU should not be changed by the BTS, the PCU sets the RI field to '0' in the PCU-TRAU frame being sent to the BTS that corresponds to

20 the assigned sending permission. Also when fixed allocation is used, the PCU sets the RI bit to '0' when an MS using fixed allocation is about to transmit. That way the BTS may not replace the sending permission with MS's id and the MS to which the sending permission was originally assigned may transmit without disturbance.

25 Alternatively, the BTS can keep a record of sending permissions reserved in advance. For example, when an MS makes a two-phase access, the PCU assigns the MS one sending permission (one BP) on one time slot in which the MS sends a Packet Resource Request message to the network. The sending permission is usually assigned over half a second ahead in time

30 when the PCU handles the two-phase access request. The sending permission is assigned to an MS in an Assignment message that is sent from the PCU to the BTS and from the BTS to the MS. When the BTS receives such an Assignment message, the BTS should keep a record of the assigned sending permission in order not to replace the assigned sending permission if the MS

35 has data to be transmitted. Also when the PCU polls an MS with an RRBP field in an RLC/MAC block, the BTS should keep a record of those pollings in

order not to assign the same BP for two different MSs. In case fixed assignment is used, the BTS should keep track of the allocated BPs, which means that either the BTS decodes the assignment messages sent to the MS or the PCU tells the BTS of the assigned sending permissions.

5 The usage of the RI field in the PCU-TRAU frame is advantageous because then the BTS does not have to keep record of pre-assigned sending permissions (e.g. as part of a two-phase access procedure or an RRBP polling procedure). Thus the operation of the BTS is simpler.

10 An example of the operation of the invention is given below. Sending permissions on one time slot (channel) are described. The following example also enlightens one embodiment of the invention. Provided that the BTS is allowed to assign sending permissions (e.g. the value of the RI bit is '0') and the response to polling indicates that the MS has data to be sent, BTS may replace sending permissions of other MSs with a sending permission of the 15 MS.

Figures 5A, 5B and 5C illustrate sending permissions assigned to three mobile stations MS1, MS2 and MS3 for block periods BP1–BP12. The 20 mobile station (MS1, MS2 or MS3) to which a sending permission for a block period is assigned is indicated below the block period number, e.g. MS1 below BP1 indicates that an uplink sending permission for block the period 1 is assigned to the MS1.

25 In Figure 5A the PCU assigns an MS (denoted by MS1) having a silent period sending permission every third BP. Two other MSs (MS2 and MS3) are assigned sending permissions between the polling of the MS1. After noticing the MS1 has data to be transmitted, the PCU assigns the MS1 a sending permission on every BP. According to the normal polling procedure, the MS1 starts receiving additional sending permissions from 11th block period as illustrated.

30 In Figures 5B and 5C the PCU assigns an MS (MS1) having a silent period sending permission every third BP. Two other MSs (MS2 and MS3) are assigned sending permissions between the polling of the MS1. Sending permissions assigned by the PCU are illustrated in Figure 5B. When the BTS utilizing the invention notices the MS1 has more data to be transmitted, the BTS replaces sending permissions of other MSs with a sending permission of the 35 MS1. Actual sending permissions which are sent to the MS1 after the BTS has modified the sending permissions are illustrated in Figure 5C. As can be seen

the MS1 receives additional sending permissions starting already from the 2nd BP (BP2). When the BTS participates in the sending permission assignment operation being performed for the MS1, the MS1 receives enough sending permissions immediately when it has data to transmit after a silent period.

5 When the BTS replaces sending permissions assigned by the PCU or forms a new assignment bitmap for the MS, the BTS may optionally inform the PCU about it. The notification may be included e.g. into uplink PCU-TRAU frame control information. That way the PCU knows about the replacement or the change in the fixed allocation and does not expect an RLC/MAC block 10 from some other MS.

15 Although the invention has been described above with a system dividing the transmission path on the air interface between several users by a time division multiple access (TDMA), it is obvious to one skilled in the art how to apply the invention in connection with other multiple access modulation techniques, such as code division multiple access (CDMA), frequency division 20 multiple access (FDMA) or combinations of different techniques.

It will be obvious to a person skilled in the art that as the technology advances, the inventive concept can be implemented in various ways. Thus the invention and its embodiments are not limited to the examples described 20 above, but they may vary within the scope of the claims.

CLAIMS

1. A method for assigning sending permissions in a communications system comprising a unit providing access to said system for at least one communication terminal and a control unit for scheduling data transfer between said at least one communication terminal and the communications system, whereby the control unit is located apart from the access providing unit and whereby said data transfer takes place on at least one transmission channel and more than one communication terminal is arranged to use the same transmission channel so that a communication terminal is allowed to send on the transmission channel when a sending permission is assigned to said communication terminal,
characterized by the method comprising the step of assigning in the access providing unit a sending permission to the communication terminal.
2. A method according to claim 1 characterized by performing the said assignment in the access providing unit in response to receiving in the access providing unit an indication from the communication terminal, the indication indicating that the communication terminal has data to be sent.
3. A method according to claim 1 or 2, characterized by the method further comprising the step of assigning at least one sending permission in the control unit, and
the sending permission assigned in the access providing unit being one of the sending permissions assigned in the control unit.
4. A method according to claim 3 characterized by the method further comprising the step of informing the access providing unit about said assignment of a sending permission in the control unit.
5. A method according to claims 2, 3 or 4 characterized by the method further comprising the step of forwarding the indication to the control unit.
6. A method according to claim 1, characterized by the method comprising the steps of:
assigning in the control unit a first sending permission to the communication terminal,
informing the access providing unit about said assignment, and

assigning in the access providing unit a second sending permission to the communication terminal in response to receiving in the access providing unit a response due to the first sending permission from the communication terminal, the response indicating that the communication terminal has data to be sent.

5 7. A method according to claim 6 **characterized** by the method further comprising the step of forwarding said response to the control unit.

10 8. A method according to claim 1 **characterized** by the method further comprising the steps of:

assigning in the control unit a first sending permission to a first communication terminal,

receiving in the access providing unit an indication from a second communication terminal that it has data to be sent,

15 15. assigning from the access providing unit the first sending permission to the second communication terminal.

20 9. A method according to any of the preceding claims, **characterized** by assigning sending permissions in the access providing unit to the communication terminal until the communication terminal indicates that it has no more data to be sent.

10. A method according to any of the preceding claims **characterized** by the method further comprising the steps of:

dividing the transmission channel into time periods, and

25 allowing the communication terminal to send on the transmission channel during a time period for which the sending permission is assigned to the said communication terminal.

11. A method according to claim 10, **characterized** by assigning sending permissions for one time period at a time.

30 12. A method according to claim 10 or 11, **characterized** by the method further comprising the step of indicating from the control unit to the access providing unit time periods for which it is not allowed to assign a sending permission from the access providing unit to a communication terminal other than that already defined in the control unit.

35 13. A method according to claim 10, 11 or 12 **characterized** by the method further comprising the step of keeping a record in the access providing unit of sending permissions for time periods that have been

reserved in advance whereby sending permissions for such a reserved time period is not assigned in the access providing unit to a communication terminal other than that having a reservation for the time period in question.

14. A method according to claim 10, 11, 12 or 13, **characterized** by the communications system supporting the General Packet Radio Service (GPRS), the access providing unit being a base station and the control unit being a packet control unit (PCU).

5 15. A method according to claim 14, **characterized** by said time period being a block period.

10 16. A method according to claim 14 or 15, **characterized** by assigning a sending permission to a communication terminal by including an identifier of the communication terminal in an RLC/MAC block sent to the communication terminal.

15 17. A method according to claim 16, **characterized** by said identifier being an Uplink State Flag (USF) allocated for the communication terminal.

20 18. A method according to claim 16 or 17, **characterized** by assigning in the base station a sending permission to the communication terminal by replacing in the access providing unit the identifier of the communication terminal to a RLC/MAC block to be forwarded to the communication terminal.

19. A method according to any of the preceding claims **characterized** by said communications system being a telecommunications system.

25 20. A method according to any of the preceding claims **characterized** by said communication terminal being a telecommunication terminal.

30 21. A communications system comprising a unit (20) providing access to said system for at least one communication terminal (40) and a control unit (11) for scheduling data transfer between said at least one communication terminal and the communications system, whereby the control unit (11) is located apart from the access providing unit (20) and whereby said data transfer takes place on at least one transmission channel and more than one communication terminal is arranged to use the same transmission channel so that a communication terminal is allowed to send on the transmission channel when a sending permission is assigned to said communication terminal,

characterized in that

the access providing unit (20) is arranged to assign a sending permission to the communication terminal.

22. A communications system according to claim 21, **characterized** in that the access providing unit (20) is arranged to perform said assignment in response to receiving an indication from the communication terminal, that the communication terminal has data to be sent.

23. A communications system according to claim 21, **characterized** in that

10 the control unit (11) is arranged to assign a first sending permission to a first communication terminal (40) and to inform the access providing unit (20) about the first assignment, and

15 the access providing unit (20) is arranged to assign the first sending permission to a second communication terminal in response to receiving an indication from the second communication terminal, that the communication terminal has data to be sent.

24. A communications system according to claim 21, 22 or 23, **characterized** in that the access providing unit (20) is arranged to forward the indication to the control unit.

20 25. A communications system according to claim 21, 22 23 or 24 **characterized** in that

the control unit (11) is arranged to assign a first sending permission to the communication terminal (40) and to inform the access providing unit (20) about said assignment, and

25 the access providing unit (20) is arranged to assign a second sending permission to the communication terminal in response to receiving a response due to the first sending permission from the communication terminal, which response indicates that the communication terminal has data to be sent.

26. A communications system according to claim 25 **characterized** in that the access providing unit (20) is arranged to forward the response to the control unit.

30 27. A communications system according to any one of claims 21 to 26, **characterized** in that the access providing unit (20) is arranged to assign sending permissions to the communication terminal (40) until the communication terminal indicates that it has no more data to be sent.

28. A communications system according to any one of claims 21 to 27, characterized in that the system is arranged to divide the transmission channel into time periods and to allow the communication terminal (40) to send on the transmission channel during a time period for which the sending permission is assigned to the communication terminal.

5 29. A communications system according to claim 28, characterized in that sending permissions are assigned for one time period at a time.

10 30. A communications system according to claim 29, characterized in that the control unit (11) is arranged to indicate to the access providing unit (20) time periods for which the access providing unit is not allowed to assign a sending permission to a communication terminal (40) other than that already defined in the control unit.

15 31. A communications system according to claim 29 or 30, characterized in that the access providing unit (20) is arranged to keep a record of sending permissions for time periods that have been reserved in advance in order not to assign sending permissions for such a reserved time period to a communication terminal other than that having a reservation for the time period in question.

20 32. A communications system according to claim 29, 30 or 31, characterized in that the communications system supports the General Packet Radio Service (GPRS), the access providing unit (20) is a base station and the control unit (11) is a packet control unit (PCU).

25 33. A communications system according to claim 32, characterized in that said time period is a block period.

34. A communications system according to claim 32 or 33, characterized in that a sending permission is assigned to a communication terminal (40) by including an identifier of the communication terminal in an RLC/MAC block sent to the communication terminal.

30 35. A communications system according to claim 34, characterized in that said identifier is an Uplink State Flag (USF) allocated for the communication terminal.

36. A communications system according to claim 34 or 35, characterized in that the access providing unit (20) is arranged to assign a sending permission to the communication terminal (40) by replacing the identi-

fier of the communication terminal to an RLC/MAC block to be forwarded to the communication terminal.

37. An access providing unit for providing access to a communications system for at least one communication terminal (40) said system comprising a control unit (11) for scheduling data transfer between said at least one communication terminal and the communications system, whereby the control unit is located apart from the access providing unit (20) and whereby said data transfer takes place on at least one transmission channel and more than one communication terminal is arranged to use the same transmission channel so that a communication terminal (40) is allowed to send on the transmission channel when a sending permission is assigned to said communication terminal,

characterized in that

15 the access providing unit (20) is arranged to assign a sending permission to the communication terminal (40).

38. An access providing unit according to claim 37, **characterized** in that the access providing unit (20) is arranged to perform said assignment in response to receiving an indication from the communication terminal that the communication terminal has data to be sent.

20 39. An access providing unit according to claim 37 or 38, **characterized** in that the access providing unit (20) is arranged to receive from the control unit information about an assignment of a first sending permission to a first communication terminal, and to assign the first sending permission to a second communication terminal in response to receiving an indication from the second communication terminal, that the communication terminal has data to be sent.

25 40. An access providing unit according to claim 38 or 39, **characterized** in that the access providing unit (20) is arranged to forward the indication to the control unit (11).

30 41. An access providing unit according to claim 37, 38, 39 or 40, **characterized** in that

the access providing unit (20) is arranged to receive from the control unit information about an assignment of a first sending permission to a first communication terminal, and

35 to assign a second sending permission to the first communication terminal (40) in response to receiving a response due to the first sending per-

mission from the communication terminal, which response indicates that the communication terminal has data to be sent.

42. An access providing unit according to claim 41, **characterized** in that the access providing unit (20) is arranged to forward the response to the control unit.

43. An access providing unit according to any of claims 37 to 42, **characterized** in that the access providing unit (20) is arranged to assign sending permissions to the communication terminal (40) until the communication terminal indicates that it has no more data to be sent.

44. An access providing unit according to any one of claims 37 to 42, **characterized** in that

the communications systems comprising the access providing unit (20) is arranged to divide the transmission channel into time periods, and the access providing unit (20) is arranged to assign sending permissions for one time period at a time.

45. An access providing unit according to claim 44, **characterized** in that the access providing unit (20) is arranged not to assign a sending permission to a communication terminal other than that already defined in the control unit for time periods indicated by the control unit.

46. An access providing unit according to claim 44, **characterized** in that the access providing unit (20) is arranged to keep a record of sending permissions for time periods that have been reserved in advance in order not to assign sending permissions for such a reserved time period to a communication terminal other than that having a reservation for the time period in question.

47. An access providing unit according to any one of claims 37 to 46, **characterized** in that the access providing unit (20) is a base station of a communications system supporting the General Packet Radio Service (GPRS)...

48. An access providing unit according to claim 47, **characterized** in that the access providing unit (20) is arranged to assign a sending permission to a communication terminal (40) by including an identifier of the communication terminal in an RLC/MAC block sent to the communication terminal.

49. An access providing unit according to claim 48, **characterized** in that the access providing unit (20) is arranged to assign a

sending permission to the communication terminal (40) by replacing the identifier of the communication terminal to an RLC/MAC block to be forwarded to the communication terminal.

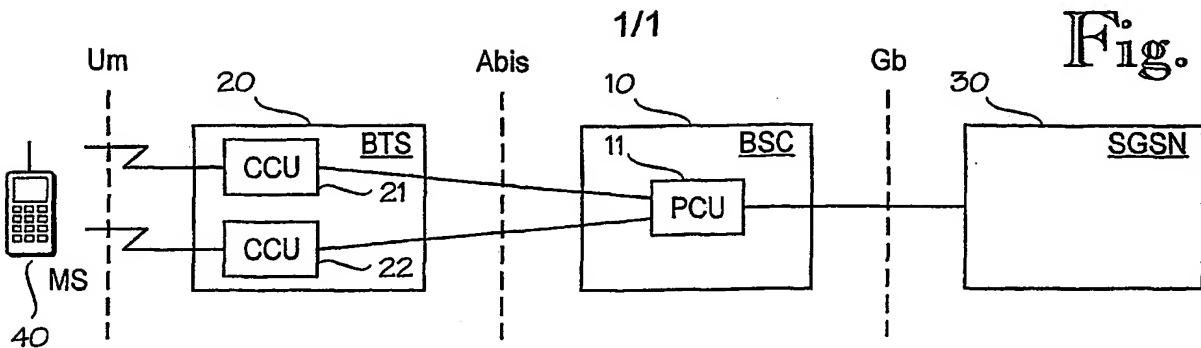


Fig. 2

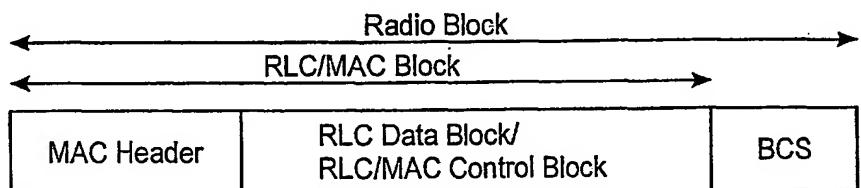
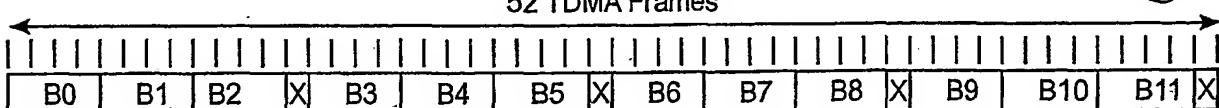


Fig. 3

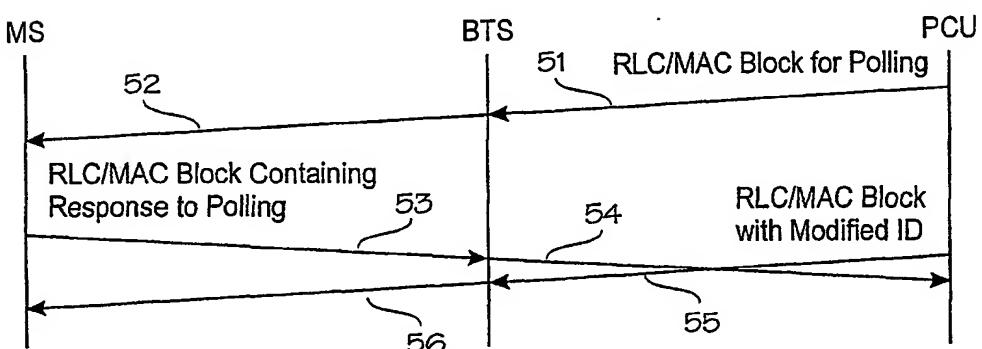


Fig. 4

BP1 BP2 BP3 BP4 BP5 BP6 BP7 BP8 BP9 BP10 BP11 BP12
MS1 | MS2 | MS3 | MS1 | MS2 | MS3 | MS1 | MS2 | MS3 | MS1 | MS1 | MS1 |

Fig. 5A

BP1 BP2 BP3 BP4 BP5 BP6 BP7 BP8 BP9 BP10 BP11 BP12

MS1 | MS2 | MS3 | MS1 | MS2 | MS3 | MS1 | MS2 | MS3 | MS1 | MS1 | MS1 |

Fig. 5B

BP1 BP2 BP3 BP4 BP5 BP6 BP7 BP8 BP9 BP10 BP11 BP12

MS1 | MS1 |

Fig. 5C

BP1 BP2 BP3 BP4 BP5 BP6 BP7 BP8 BP9 BP10 BP11 BP12

MS1 | MS1 |

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 01/00681

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04J, H04L, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI DATA, EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service description; Stage 2 (GSM 03.60 version 7.1.1 release 1998). ETSI EN 301 344 V7.1.1 (2000-01) Chapter 12.7 - 12.7.1 --	1-5,9-22, 26-38,40, 43-49
X	WO 9857509 A2 (MOSLEMIE, A. ET AL.), 17 December 1998 (17.12.98), page 12, line 19 - line 28 --	1-5,9-22, 26-38,40, 43-49
A	US 6205157 A (GALYAS, J.K.P. ET AL.), 20 March 2001 (20.03.01), column 3, line 20 - line 30 --	1-49

 Further documents are listed in the continuation of Box C. Sec patent family annex.

* Special categories of cited documents:

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 "B" earlier application or patent but published on or after the international filing date
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 "O" document referring to an oral disclosure, use, exhibition or other means
 "P" document published prior to the international filing date but later than the priority date claimed

"F" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search

Date of mailing of the international search report

18 October 2001

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 01/00681

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5978368 A (HJELM, S. ET AL.), 2 November 1999 (02.11.99), column 4, line 21 - line 40 --	1-49
P,A	WO 0120930 A1 (TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)), 22 March 2001 (22.03.01), abstract -----	1-49

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.	
PCT/FI 01/00681	

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US	6205157	A	20/03/01	AU 731007 B AU 4890397 A BR 9712464 A EP 0935853 A HU 0000023 A JP 2001503587 T WO 9820627 A AU 4890497 A BR 9712478 A EP 0935867 A JP 2001506068 T US 6215798 B US 2001000701 A WO 9820655 A	22/03/01 29/05/98 26/10/99 18/08/99 28/05/00 13/03/01 14/05/98 29/05/98 26/10/99 18/08/99 08/05/01 10/04/01 03/05/01 14/05/98
US	5978368	A	02/11/99	AU 4298399 A BR 9910067 A CN 1308818 T DE 19983154 T GB 0026383 D GB 2354136 A WO 9957924 A	23/11/99 26/12/00 15/08/01 17/05/01 00/00/00 14/03/01 11/11/99
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